

Status of RFQ Injector (PIP)

C.Y. Tan
05 Dec 2012

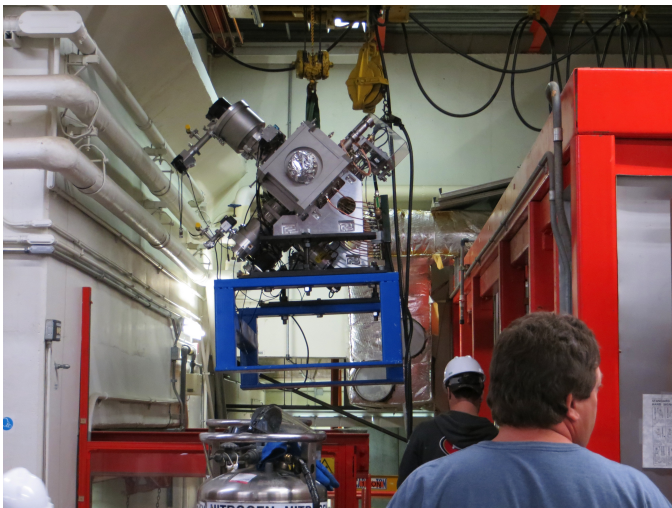
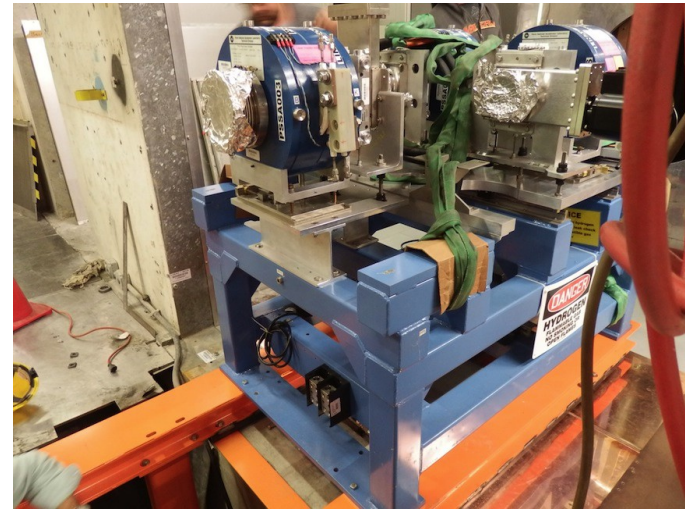
Acknowledgements

- Mechanical techs: B. Ogert, J. Briney, J. Kubinski.
- Vacuum: K. Triplett, J. Larson.
- Controls: M. Kucera, D. Arveson.
- EE support: S. Hays, M. Dilday, Brad Claypool.
- Scheduling: M. Convery (especially Mary's IMPOSSIBLE to break schedule!)
- Survey group.
- RFQ injector group.

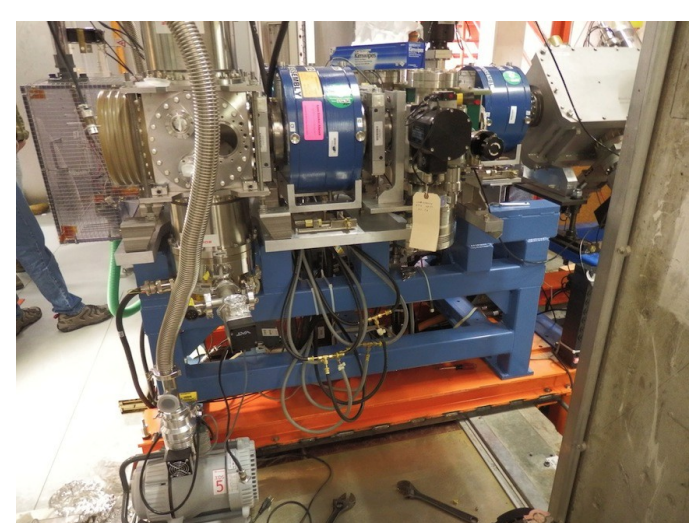
Installation history for getting to NTF operations

- Moved everything from test area to final injector line.
 - Connect power and controls, vacuum, water etc.
 - Align elements.
 - Test new setup without MEBT to make sure everything installed correctly!
- Connected MEBT to Tank 1
 - Beam studies to maximize beam at start of Tank 1 and Tank 3
- Install chopper
- Good for NTF operations!
- In the last possible moment: H- source stopped sparking! (But of course, we had to have a 4 day shutdown)

Moving! (05 Oct – 12 Oct 2012)



Power, water, vacuum and controls (12 Oct – 28 Oct 2012)

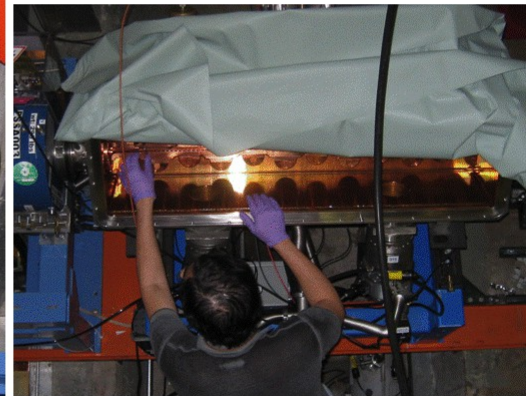


Halloween nightmare

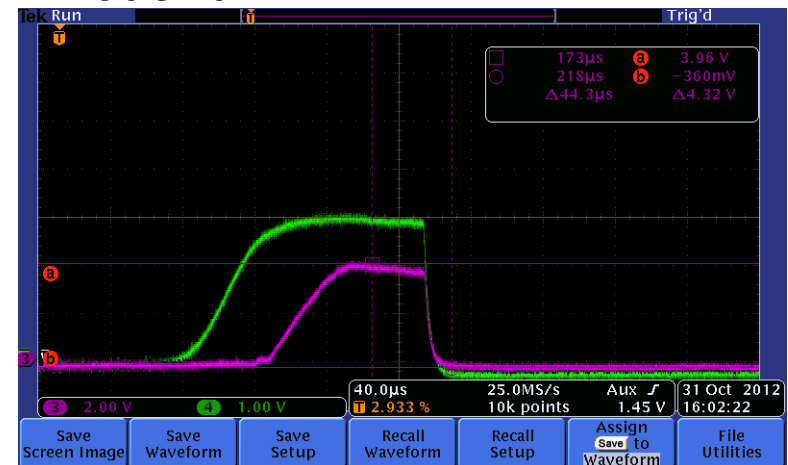
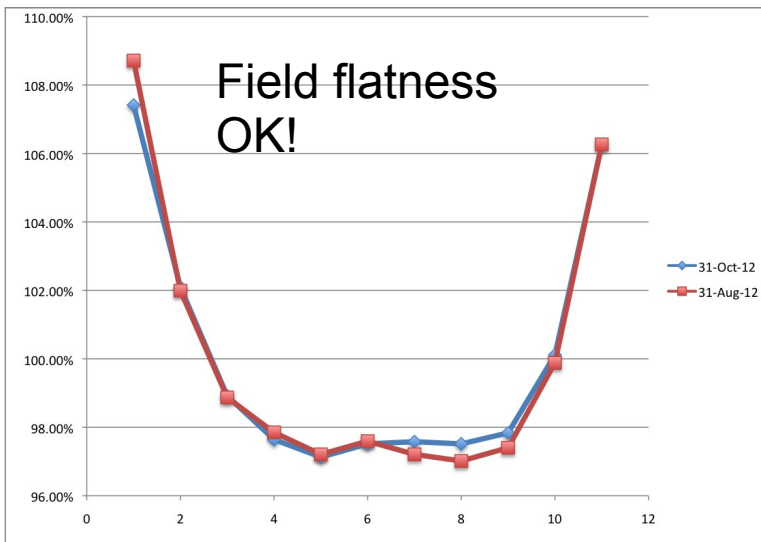
First try: we only got ~20 mA at the exit of the RFQ????



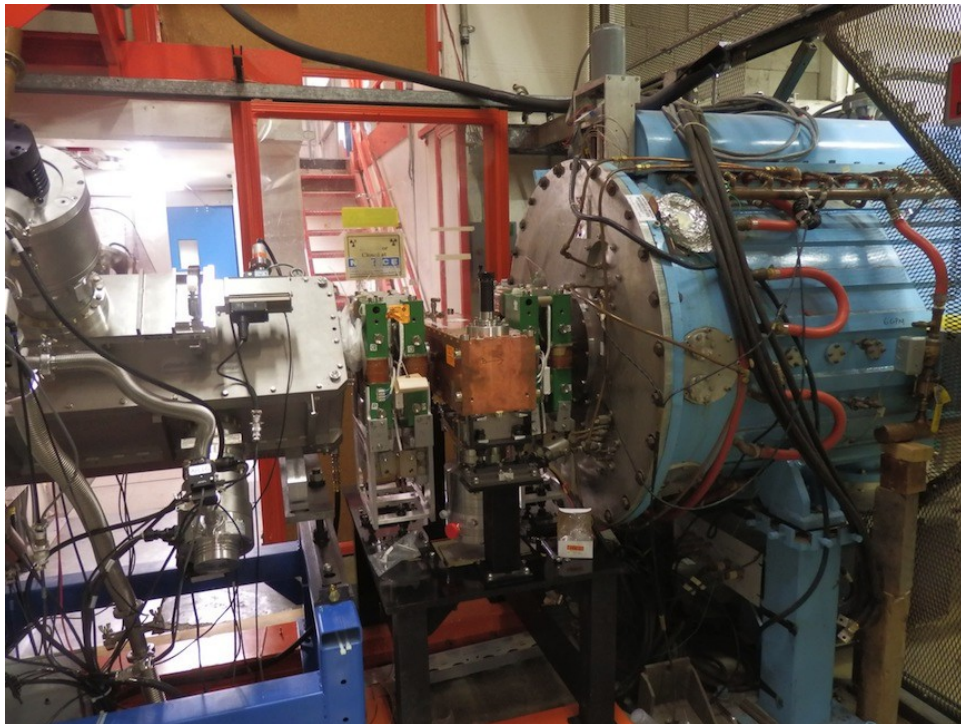
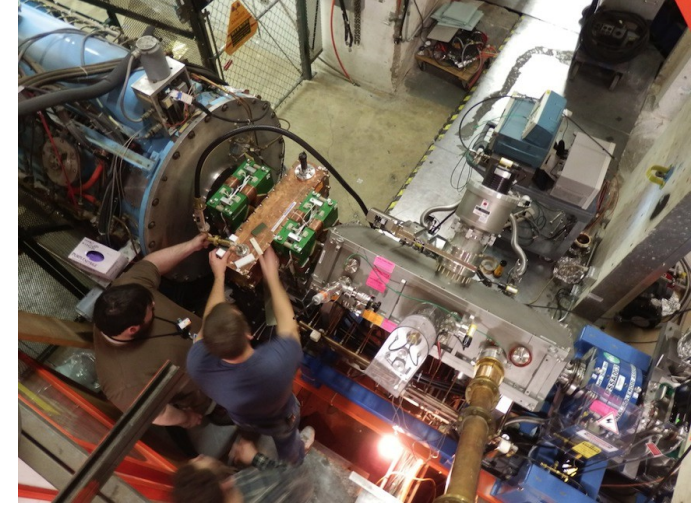
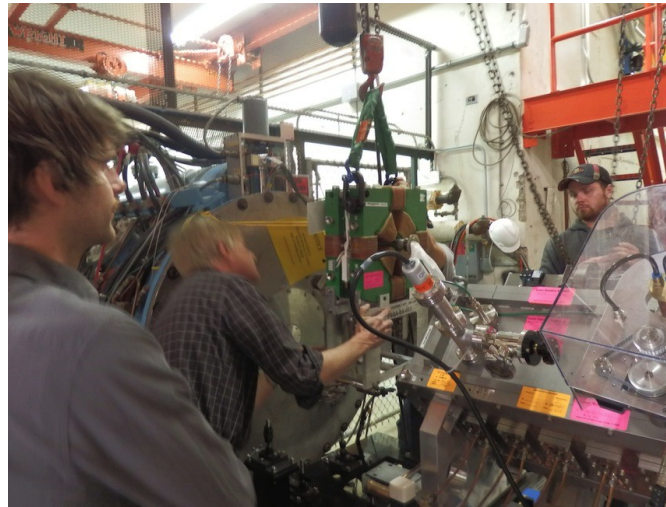
Tan working on field flatness measurements (proof that he actually does work!)



Fixed solenoid PS. Got 43 mA at exit

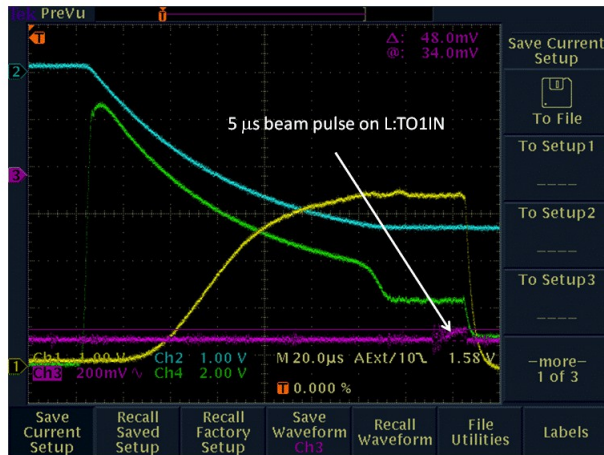


Install MEBT (02 Nov – 19 Nov 2012)

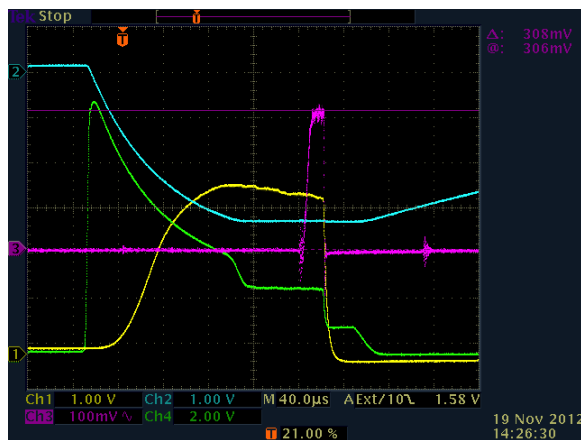


Major milestone: The new RFQ injector is linked to the Linac! But power, water and RF still needs to be connected. This was completed on 19 Nov.

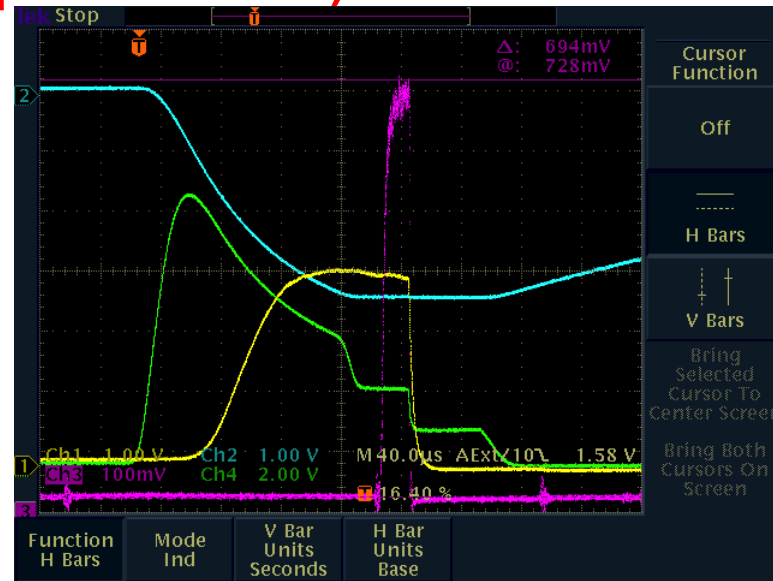
RFQ Injector Commissioning (19 Nov 2012 until present ...)



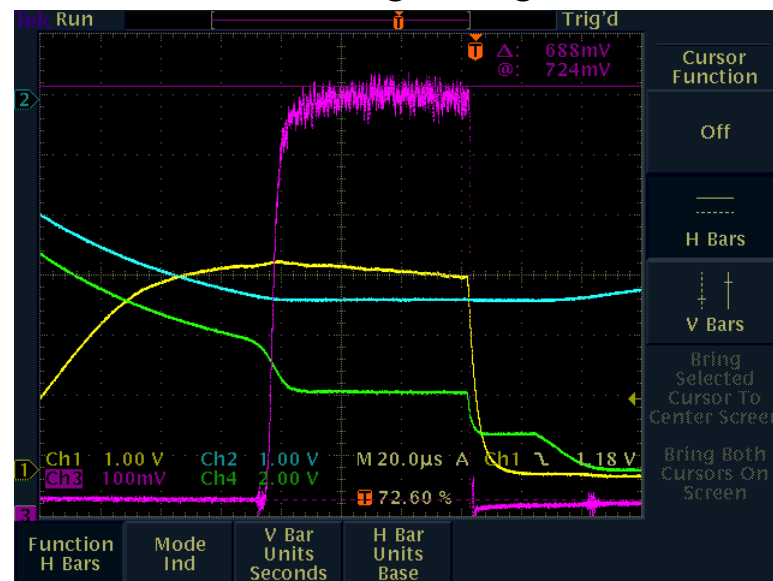
First beam through MEBT and at the beginning of Tank 1!



More tuning 14 mA

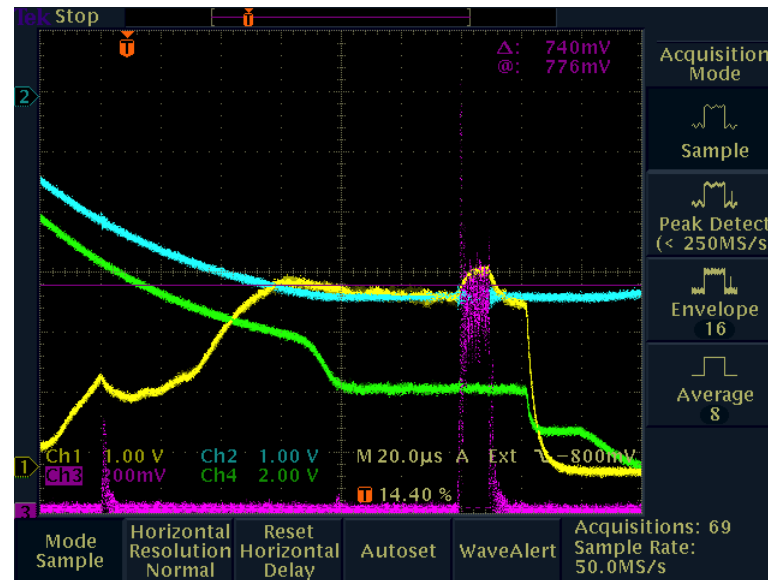
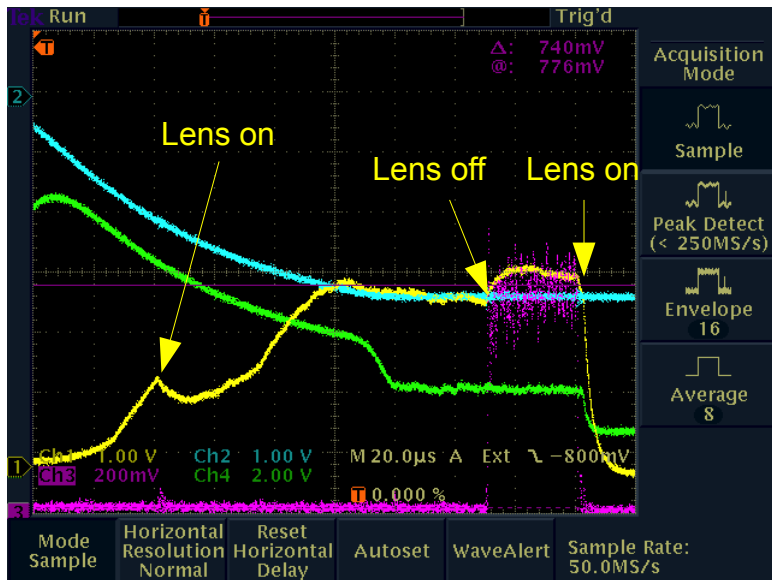


Even more tuning, we get 30 mA



Increased pulse width for NTF

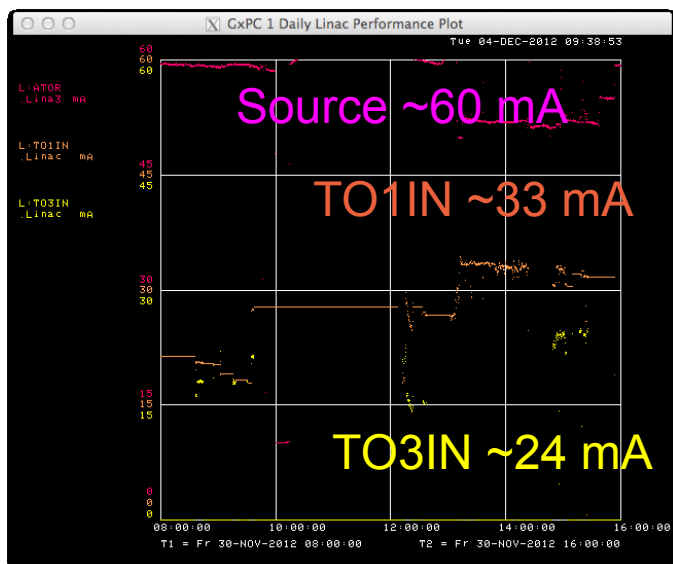
Einzel lens chopper



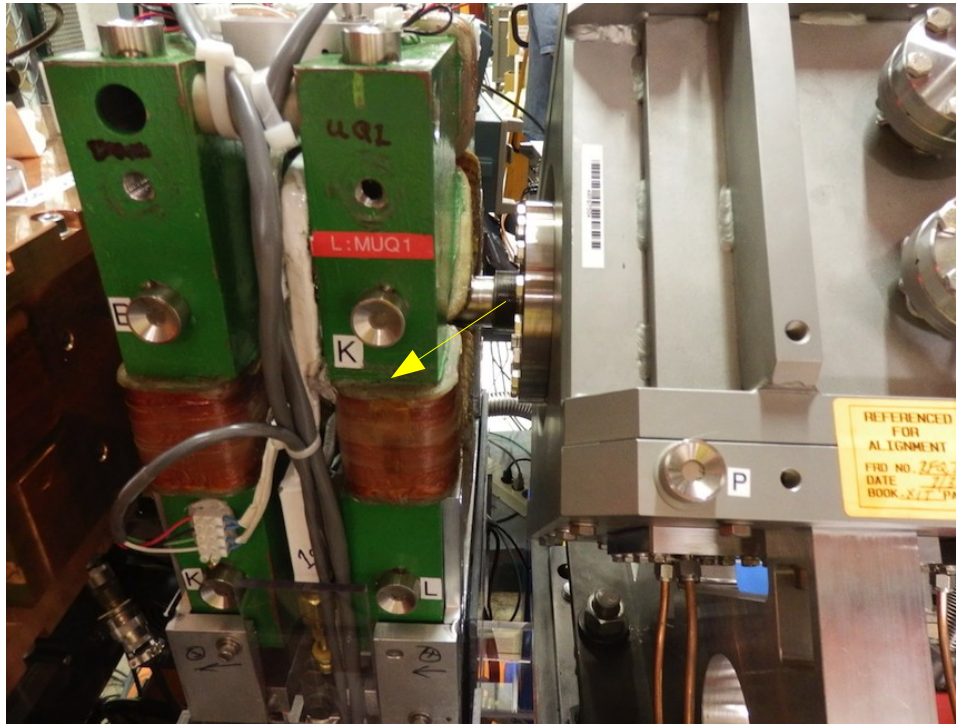
We get MORE beam with chopper on. 33.6 mA!

Needs more tuning. No tuning since chopping started.

What happened to 10 mA in the MEBT?



Beam out of RFQ has a large angle!



Angle may be as large as 2 deg!
(mostly vertical)

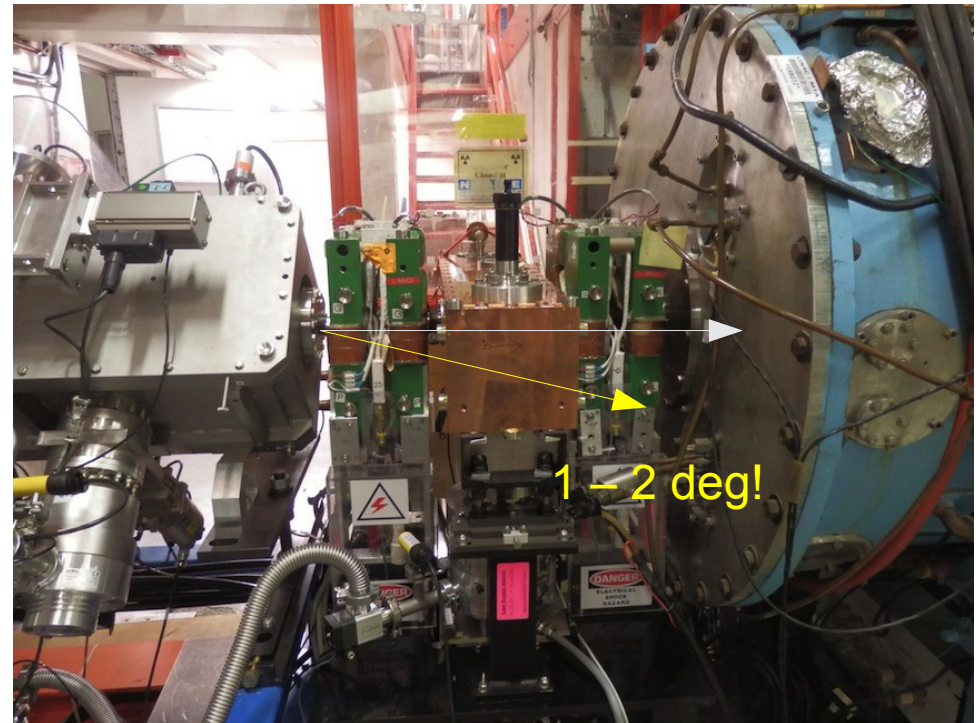
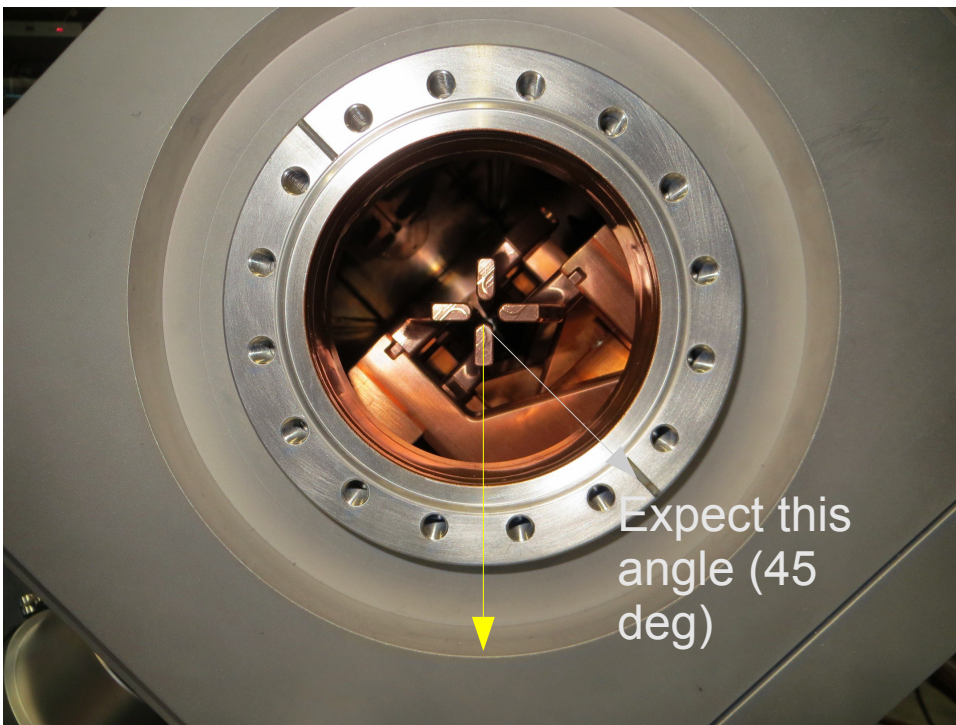
Indications of the problem is that
the first vertical corrector has to
run VERY HARD ~ 2.5 A.
Emittance probes show this angle.
Downstream quads deflect beam
vertically.

More studies to better quantify and
model the angle.

One solution is to build BNL style
thin corrector.

Large angle may be causing beam loss by scraping – Fixing this can
possibly give us more beam.

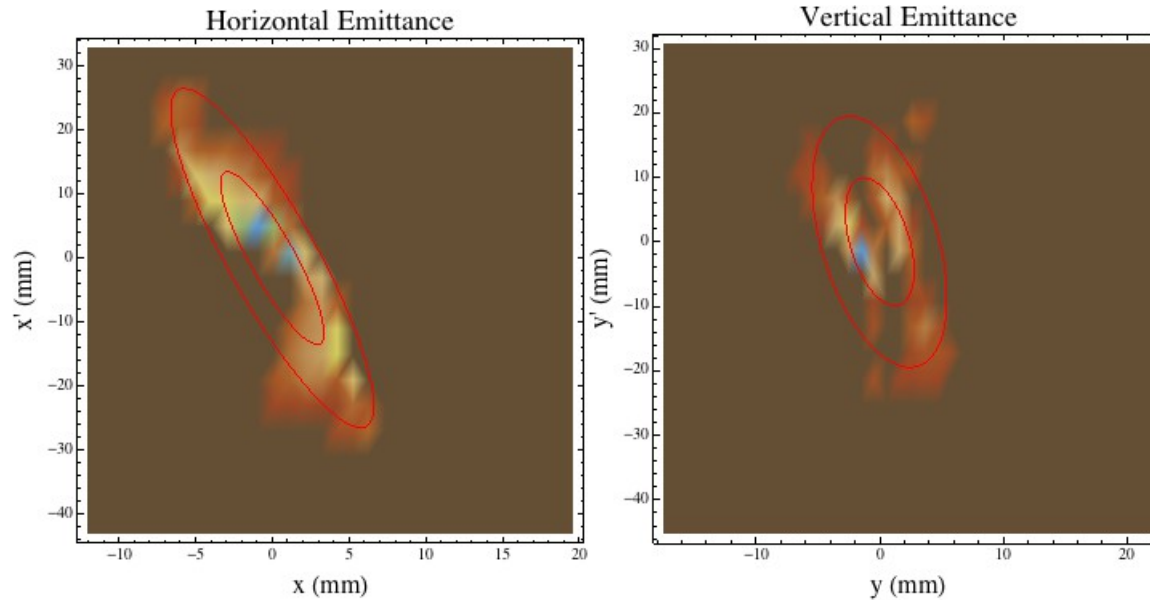
Approximate beam trajectory out of RFQ



Initial measurements with emittance probes show 1 – 2 deg angle out of the RFQ. More machine studies to confirm.

From the asymmetry of the RFQ mounting, I would have expected a 45 deg azimuthal angle and not vertically down. **However, this is PRELIMINARY and subject to change!**

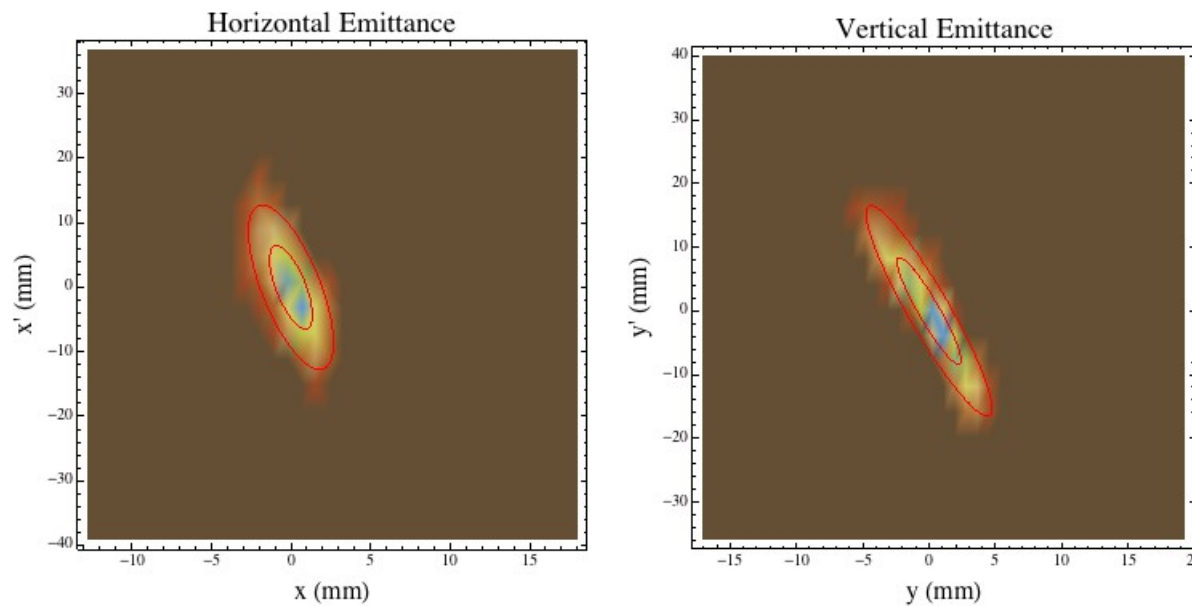
Emittance Measurements



All emittances are normalized rms.

“Flat” beam before shutdown
 $\epsilon_x = 0.9\pi$ mm mrad
 $\epsilon_y = 1\pi$ mm mrad
@ 46 mA in buncher

RFQ beam at start of
Tank 1.



$\epsilon_x = 0.26\pi$ mm mrad
 $\epsilon_y = 0.31\pi$ mm mrad
@ 30 mA at Tank 1

Exit of RFQ measured in
test room:

$\epsilon_x = 0.6\pi$ mm mrad
 $\epsilon_y = 0.5\pi$ mm mrad
@ 40 mA

Scraping? Space charge

Plans

- Figure out whether there is an angle out of the RFQ.
- Add power power to the buncher for better matching into Tank 1.
- More tuning with chopper on.
- Goal is to get 40 mA at the start of Tank 1.
Only 7 mA to go!!!!